

**Photography for Entomologists** (*with two plates*).

By FREDERICK NOAD CLARK.

When first I took up this work in connection with entomology, some fifteen years ago, although I could foresee the many applications it would have in every branch of natural history, I did not imagine that it would have been in comparatively so short a time so extensively utilised in our study. At that time photo process work was in its infancy, and the low standard of quality then obtaining was no doubt responsible for a good deal of shortcoming in this respect. It cannot, however, be said that this is the case at the present time, now that photographic reproduction processes have been brought to such a high state of perfection, and are being employed by our best known authorities in every branch of entomology. Some reproductions from drawings and diagrams are excellent in their way, and in many instances are indispensable, but for accuracy of delineation they are not to be compared with the results obtainable by photography. When employed in conjunction with the microscope, as in photomicrography, its advantages in demonstrating the minute structure or anatomy of insects are obvious. Absence of the "personal equation" is also a point that should not be overlooked. In the study of entomology there is no lack of material or scope for the practice of photography.

**LOW POWER PHOTOGRAPHY.**—By this I mean the photography of those subjects which require but little or no magnification, as in the case when photographing whole insects or large portions of such. These are frequently too large to be included in the field of the low power micro-objective. In such cases we must use the photographic lens and camera. For large insects a good wide angle or short focus lens is necessary, the required magnification being obtained by camera extension. With objects intermediate in size, between the latter and those that are obviously microscopic specimens, I recommend a lens of the "Planar" type. Most opticians now supply lenses of this type, and they are indispensable for photographing such objects as eggs and the larger structures. They are somewhat costly, but in practice are extremely useful when the object is too large for the field of the low power micro-objective. Besides covering a wide field of view, they give splendid marginal definition, and, what is sometimes of even more importance, a "depth of focus" which is quite unattainable with the micro-objective. I have a 3in. lens of this type by Watson & Sons, which enables me to do work that, prior to their introduction, was out of the question. The setting up of the object requires some little skill in order to get the best results. I have in my mind's eye a group of lepidoptera which it is desired to photograph on one plate for reproduction. The insects should be high set with suitably long pins, and pinned on slender pieces of cork about an inch long, which latter are fixed with sealing wax or shellac on a sheet of ground glass. The whole is then photographed by daylight, using a mirror at the back of the ground glass so as to neutralise any shadows cast by the insects, should this be desirable.

**PHOTOMICROGRAPHY.**—To produce really good work the microscopist must be an expert photographer. Many who are old hands with the microscope, when attempting photomicrography, fail solely on account

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of a want of practical experience in plain photography. I do not, however, minimise the importance of a knowledge of the optical principles involved in the use of the microscope. The usual method of photographing with the microscope is by the employment of an ordinary photographic camera, one having a triple extension for preference. The microscope is brought to the horizontal position, and the upper end of the tube attached to the camera front, at the lens aperture, by two loose inter-fitting flanges, so as to exclude the light. The camera lens is, of course, dispensed with. The object is then illuminated by the direct rays of a lamp exactly in the optical axis of the microscope, a bull's eye condenser being placed between it and the substage condenser. For low and medium power work the microscopic eyepiece is quite unnecessary. Indeed, the camera itself may be dispensed with, the principle being that the microscope and illuminant are screened off from the sensitive plate by means of a box having one side removed and replaced by a dark curtain. The room being dark, takes the place of the camera chamber. The image is focussed on the screen in a plate-holder, which can be adjusted on a sliding base to the required distance from the microscope, this distance depending on the amount of magnification required. The advantages of working in this way are—that a dark slide is unnecessary, and thus any movement after final focussing is obviated; the danger from reflected light is also less. Accurate focussing is not possible on the ground glass screen, on account of the coarseness of its grain, so after roughly focussing the image on the latter, we replace it by a piece of plain glass and focus the aerial image with an ordinary photographic focussing lens. When the degree of magnification required necessitates a long camera extension, we have to focus by means of a rod fixed on the base-board, and attached at its further end by a leather band to the fine adjustment of the microscope. No definite guide here can be given as to the length of exposure, as it depends on the following factors—the objective used, amount of magnification, aperture of diaphragm of substage condenser, character of illuminant, speed of plate, and colour or density of object. A few trial exposures will, however, soon determine this. Hitherto, I have been treating of the photography of transparent objects, but, when dealing with opaque objects, such as eggs, etc., we have to use reflected light. The simplest method of illumination is by means of the bull's eye condenser interposed between the source of light and the surface of the object. The length of exposure is considerably more. As a general rule, when photographing insect preparations, a coloured screen is not required. When these are of a dark chitinous character, the difficulty can usually be surmounted by giving increased exposure with dilute prolonged development. Pyro-soda, with plenty of sulphite, is the developer I recommend. Isochromatic plates are necessary, and they should be "backed."

For purposes of reproduction for book illustration, and for obtaining the maximum amount of detail in the resulting print, I cannot insist too strongly on the use of a glossy paper of the print-out type. Contrast is improved thereby, and it is my experience that the process worker prefers this class of print to the matt bromide and others of this character.

Space will not permit to speak at any length on the preparation of lantern slides, it will be sufficient to remark that  $\frac{1}{4}$  plate

negatives should be employed with the object in view of their suitability for making lantern slides therefrom. The process, 'par excellence,' is the dry collodion process, and I have used a home-made collodion emulsion for many years. Plates prepared by this process have a structureless film, and give perfect detail, with a wide range of gradation in the image from clear glass to pure blacks. They have also the merit of cheapness, rapidity of preparation and drying, with permanency of the resulting slide. In most cases, the ordinary method of preparation of objects will be satisfactory, *i.e.*, treatment with liquor potassa, dehydration with alcohol, clearing with oil of cloves or turpentine, and mounting in Canada balsam. A good formula for the latter is—Canada balsam (dried), 2 parts; benzole and turpentine, of each 1 part. For some objects, however, Canada balsam is unsuitable, such as the softer and more colourless insect structures. For these, glycerine, in the form of Farrant's medium, will answer best; for others, such as some scales and wings of lepidoptera, the dry method of mounting is more suitable.

It is desirable to keep an indexed record of the subjects photographed, giving such particulars as—name of specimen, generic and specific, whether male or female, where obtained, how prepared, objective used, amount of magnification in diameters, exposure and date, and other facts that require notice. Such a record is always valuable for reference.

EXPLANATION OF PLATES VIII AND IX: NOTOLOPHUS (ORGYIA) ANTIQUA.

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| Fig. 1. Male insect, $\frac{2}{3}$ size.                   | Fig. 7. Cocoons, $\frac{2}{3}$ size.               |
| Fig. 2. Female insect depositing eggs, $\frac{2}{3}$ size. | Fig. 8. Pupæ, male and female, $\frac{2}{3}$ size. |
| Fig. 3. Eggs, group on cocoon $\times 1\frac{1}{2}$ .      | Fig. 9. Rudimentary wings of female, $\times 8$ .  |
| Fig. 4. Eggs $\times 10$ .                                 | Fig. 10. Hairs on larva $\times 10$ .              |
| Fig. 5. Larva, newly emerged $\times 10$ .                 | Fig. 11. " " " $\times 60$ .                       |
| Fig. 6. Larva, adult on lime leaf, $\frac{2}{3}$ size.     | Fig. 12. Proleg of larva $\times 32$ .             |

NOTE.—Figs. 1, 2, 3, 6, 7, and 8 have been photographed with a wide angle photographic lens. Fig. 4 by reflected light. Figs. 5, 9, 10, 11, and 12 are examples of low power photomicrography.

## Catalogue of the Palæarctic Urbicolides.

By J. W. TUTT, F.E.S.

Our study of the Palæarctic "skippers" (*A Natural History of the British Butterflies*, pp. 80-298) has carried us over a considerable amount of ground, and, in conclusion, we have drawn up the following catalogue of the species that are taken within the Palæarctic area, with the addition of some few varieties of the species that we have specially studied, that spread into the Nearctic region. It will be observed that there are many additions to those in Standinger and Rebel's *Catalog*, 3rd ed., 1901, but even so, we are not sure that the list is quite as complete as it should be, for, although we have cut out the species that inhabit western China up to the borders of Thibet, without passing the boundaries of the latter, the general resemblance of some of these species to other outlying Palæarctic forms, makes us doubt whether such should not be rightly included in our list. On the whole, however, we have decided to exclude these, and believe the following will be found a fairly accurate list of the "skippers" inhabiting the Palæarctic region:—